

PRELIMINARY DATA SUMMARY

December 1986

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

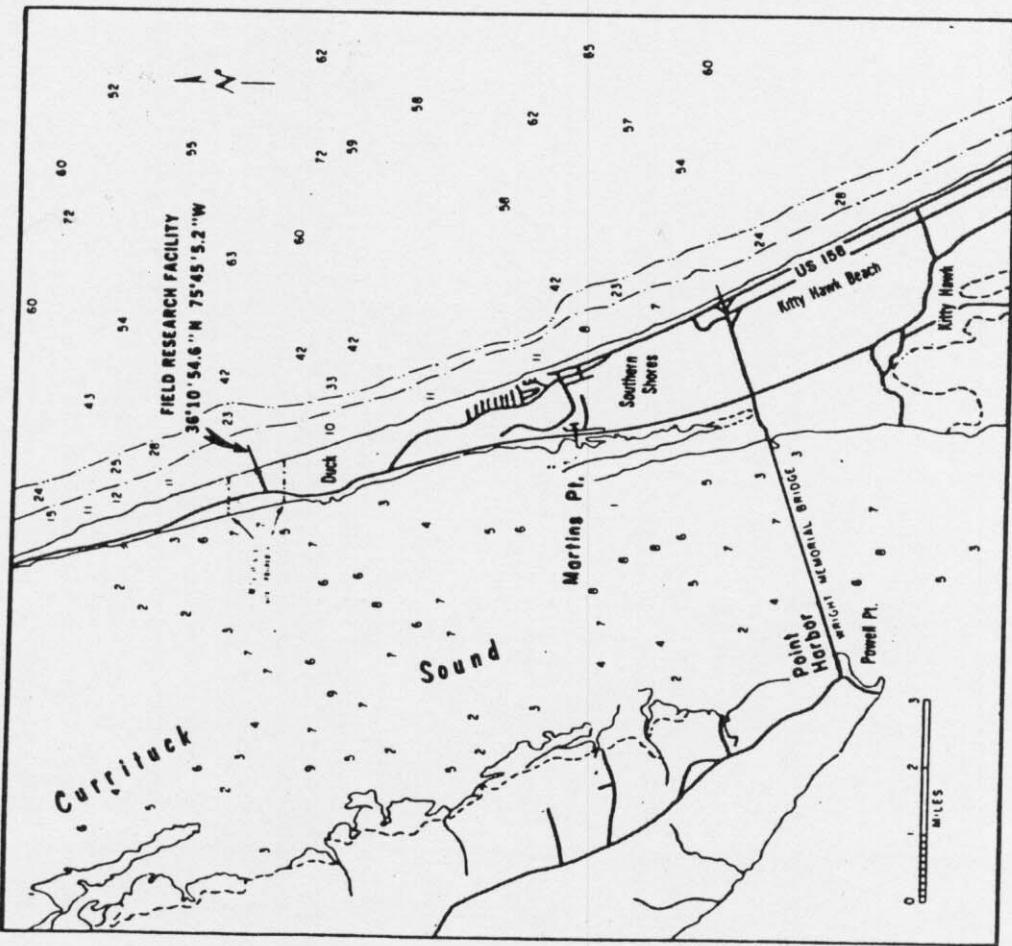
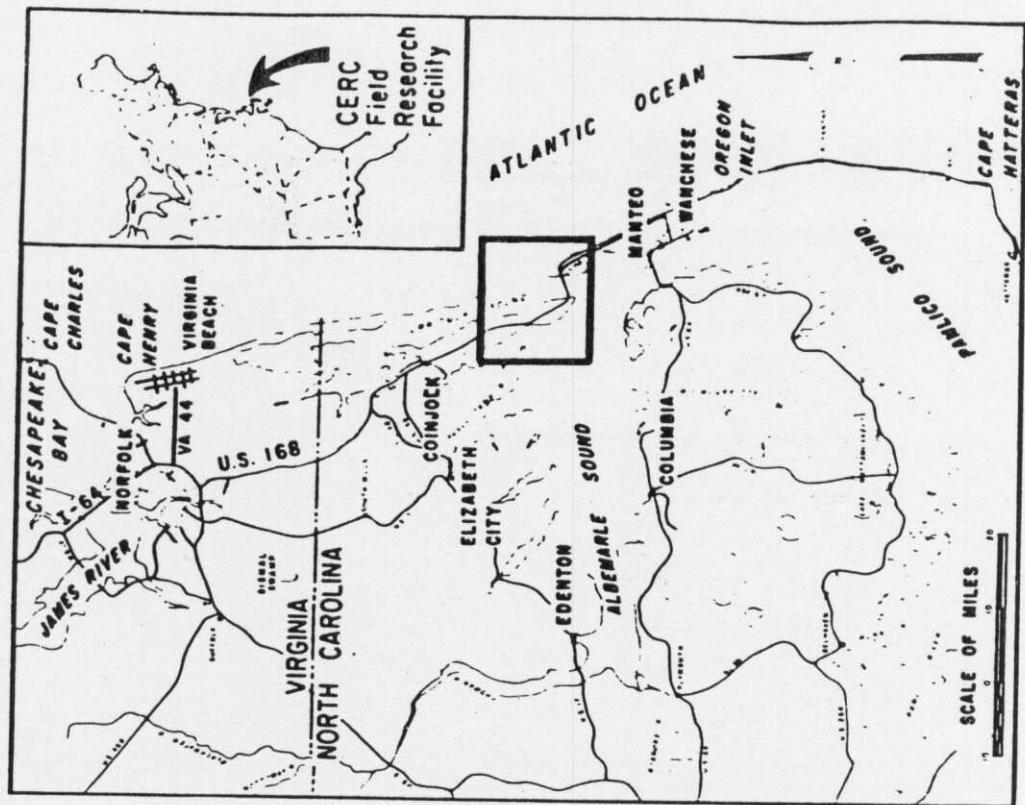


Figure 1. FRF Location Map

**TABLE 1**  
INSTRUMENT STATUS/DATA AVAILABILITY

| CAGE NUMBER | DESCRIPTION/REMARKS                                      | DEPTH AT SENSOR   | DAY OF THE MONTH  |     |     |     |      |       |       |       |       |       |       |       |       |       |
|-------------|--|-------------------|-------------------|-----|-----|-----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|             |  |                   | 1/2               | 3/4 | 5/6 | 7/8 | 9/10 | 11/12 | 13/14 | 15/16 | 17/18 | 19/20 | 21/22 | 23/24 | 25/26 | 27/28 |
|             | Barometric Pressure                                      |                   | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             |  | Data Collected    |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Analog Record  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Instrument Status  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Data Collected   |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Analog Record  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Instrument Status  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Data Collected   |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Air Temperature  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Anemometer on Lab Bldg - Elevation 19m (MSL)             |                   | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             |  | Data Collected    |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Analog Record  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Instrument Status  |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             | Data Collected   |                   |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 645         | Baylor staff located at station 7480 on FRF pier         | See profile data  | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 625         | Baylor staff located at station 19400 on FRF pier        | See profile data  | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 640         | Waverider buoy located 1.0 km from shore                 | Approx. 8.5 m MSL | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 630         | Waverider buoy located 6.0km from shore                  | Approx. 18 m MSL  | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 679         | Current meter 500m south (0.5km offshore)                | Approx. 6 m MSL   | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
| 863-1370    | NOAA primary tide station located at seaward end of pier |                   | Instrument Status |     |     |     |      |       |       |       |       |       |       |       |       |       |
|             |  | Data Collected    |                   |     |     |     |      |       |       |       |       |       |       |       |       |       |

Instrument Status: Operational  - Daily Observation: YES   
 Data Collected: ALL  , SOME

Analog Record: ALL  , PARTIAL   
 Preliminary Analysis: ALL  , SOME

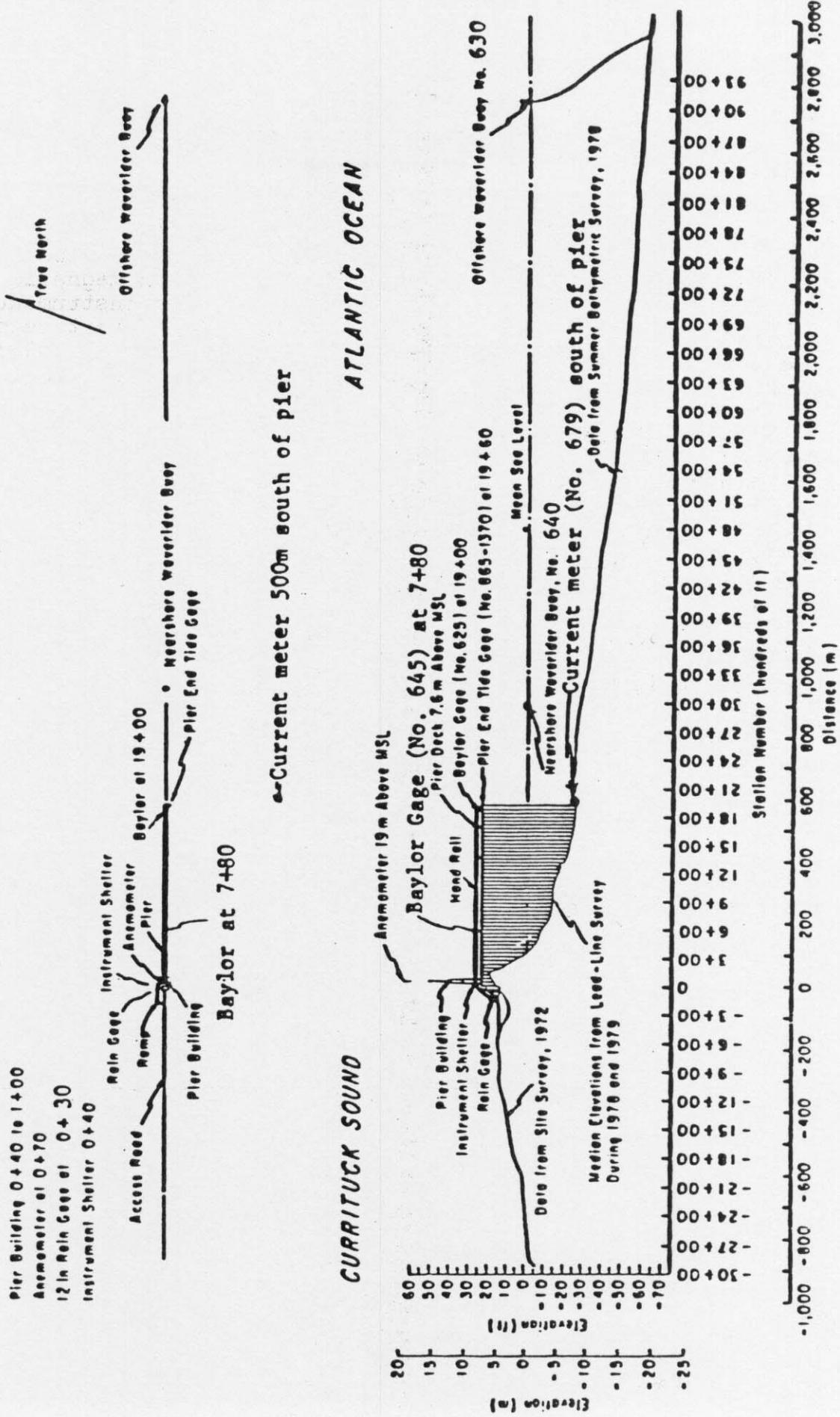


Figure 2. Instrument locations at FRF.

## II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Data General NOVA-4 computer. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -  
 $mm \times .03937 = in$
2. Millibars (mb) to inches of mercury (in Hg) -  
 $mb \times 0.02953 = in Hg$
3. Degrees Celcius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

TABLE 2: METEOROLOGICAL DATA

PART 1

DECEMBER 1986

| DAY | HOUR | WIND<br>SPEED<br>(M/S) | WIND<br>DIRECTION<br>(DEG TN) | TEMPERATURE<br>(DEG C) | ATM<br>PRESSURE<br>(MB) | PRECIPITATION<br>(MM) |
|-----|------|------------------------|-------------------------------|------------------------|-------------------------|-----------------------|
| 1   | 100  | 16                     | 45                            | 12.2                   | 1023.2                  | 0                     |
|     | 700  | 16                     | 49                            | 11.8                   | 1026.6                  | 0                     |
|     | 1300 | 17                     | 56                            | 11.9                   | 1025.6                  | 0                     |
|     | 1900 | 18                     | 60                            | 12.1                   | 1025.6                  | 0                     |
| 2   | 100  | 11                     | 89                            | 14.1                   | 1023.2                  | 0                     |
|     | 700  | 12                     | 101                           | 14.2                   | 1019.9                  | 0                     |
|     | 1300 | 12                     | 115                           | 15.6                   | 1013.5                  | 18                    |
|     | 1900 | 4                      | 184                           | 18.4                   | 1011.1                  | 3                     |
| 3   | 100  | 5                      | 220                           | 16.9                   | 1005.9                  | 0                     |
|     | 700  | 10                     | 246                           | 13.4                   | 1009.4                  | 0                     |
|     | 1300 | 9                      | 248                           | 14.0                   | 1011.7                  | 0                     |
|     | 1900 | 5                      | 253                           | 12.9                   | 1015.7                  | 0                     |
| 4   | 100  | 7                      | 290                           | 9.7                    | 1018.2                  | 0                     |
|     | 700  | 7                      | 314                           | 6.0                    | 1022.1                  | 0                     |
|     | 1300 | 5                      | 252                           | 9.9                    | 1022.6                  | 0                     |
|     | 1900 | 4                      | 274                           | 8.8                    | 1024.6                  | 0                     |
| 5   | 100  | 5                      | 279                           | 7.5                    | 1025.7                  | 0                     |
|     | 700  | 8                      | 26                            | 8.5                    | 1027.5                  | 0                     |
|     | 1300 | 6                      | 9                             | 8.9                    | 1028.5                  | 0                     |
|     | 1900 | 7                      | 358                           | 6.8                    | 1031.5                  | 0                     |
| 6   | 100  | 9                      | 19                            | 6.3                    | 1032.1                  | 0                     |
|     | 700  | 7                      | 36                            | 6.7                    | 1032.6                  | 0                     |
|     | 1300 | 6                      | 4                             | 8.6                    | 1031.8                  | 0                     |
|     | 1900 | 3                      | 9                             | 6.7                    | 1031.8                  | 0                     |
| 7   | 100  | 4                      | 316                           | 4.2                    | 1031.0                  | 0                     |
|     | 700  | 3                      | 322                           | 3.4                    | 1030.7                  | 0                     |
|     | 1300 | 1                      | 251                           | 11.6                   | 1027.8                  | 0                     |
|     | 1900 | 3                      | 205                           | 8.7                    | 1025.9                  | 0                     |
| 8   | 100  | 4                      | 245                           | 8.5                    | 1024.2                  | 0                     |
|     | 700  | 2                      | 256                           | 8.1                    | 1024.7                  | 0                     |
|     | 1300 | 3                      | 0                             | 10.3                   | 1024.9                  | 0                     |
|     | 1900 | 1                      | 53                            | 10.7                   | 1025.2                  | 0                     |
| 9   | 100  | 0                      |                               | 10.2                   | 1024.2                  | 0                     |
|     | 700  | 3                      | 132                           | 11.5                   | 1023.2                  | 0                     |
|     | 1300 | 4                      | 173                           | 17.9                   | 1019.6                  | 0                     |
|     | 1900 | 4                      | 195                           | 17.5                   | 1018.1                  | 0                     |
| 10  | 100  | 6                      | 209                           | 17.0                   | 1016.6                  | 0                     |
|     | 700  | 5                      | 240                           | 16.1                   | 1016.0                  | 0                     |
|     | 1300 | 5                      | 247                           | 19.8                   | 1014.2                  | 0                     |
|     | 1900 | 3                      | 89                            | 14.8                   | 1017.5                  | 0                     |
| 11  | 100  | 9                      | 41                            | 13.1                   | 1019.6                  | 0                     |
|     | 700  | 12                     | 48                            | 12.1                   | 1020.3                  | 0                     |
|     | 1300 | 6                      | 57                            | 12.6                   | 1014.7                  | 0                     |
|     | 1900 | 5                      | 333                           | 8.4                    | 1015.7                  | 0                     |
| 12  | 100  | 4                      | 320                           | 6.8                    | 1016.2                  | 0                     |
|     | 700  | 3                      | 294                           | 5.7                    | 1017.4                  | 6                     |
|     | 1300 | 2                      | 323                           | 7.4                    | 1014.9                  | 9                     |
|     | 1900 | 3                      | 335                           | 7.0                    | 1015.8                  | 9                     |
| 13  | 100  | 8                      | 349                           | 6.7                    | 1017.9                  | 0                     |
|     | 700  | 7                      | 312                           | 4.0                    | 1025.7                  | 0                     |
|     | 1300 | 10                     | 343                           | 3.1                    | 1031.8                  | 0                     |
|     | 1900 | 10                     | 10                            | 3.1                    | 1036.3                  | 0                     |
| 14  | 100  | 6                      | 40                            | 3.6                    | 1036.7                  | 0                     |
|     | 700  | 7                      | 34                            | 4.9                    | 1035.7                  | 0                     |
|     | 1300 | 1                      | 68                            | 8.9                    | 1032.3                  | 0                     |
|     | 1900 | 3                      | 228                           | 6.3                    | 1030.3                  | 0                     |
| 15  | 100  | 4                      | 285                           | 4.8                    | 1028.5                  | 0                     |
|     | 700  | 4                      | 296                           | 4.0                    | 1028.3                  | 0                     |
|     | 1300 | 2                      | 12                            | 8.6                    | 1026.7                  | 0                     |
|     | 1900 | 2                      | 286                           | 5.4                    | 1026.8                  | 0                     |
| 16  | 100  | 2                      | 302                           | 4.8                    | 1025.9                  | 0                     |
|     | 700  | 3                      | 347                           | 4.2                    | 1026.4                  | 0                     |
|     | 1300 | 3                      | 14                            | 12.0                   | 1024.1                  | 0                     |
|     | 1900 | 4                      | 35                            | 10.3                   | 1024.4                  | 0                     |

TABLE 2: METEOROLOGICAL DATA

PART 2

DECEMBER 1986

|    |  | WIND<br>SPEED<br>DAY HOUR | WIND<br>DIRECTION<br>(DEG TN) | TEMPERATURE<br>(DEG C) | ATM<br>PRESSURE<br>(MB) | PRECIPITATION<br>(MM) |
|----|--|---------------------------|-------------------------------|------------------------|-------------------------|-----------------------|
| 17 |  | 100 2                     | 337                           | 6.9                    | 1023.1                  | 0                     |
|    |  | 700 4                     | 352                           | 9.0                    | 1023.8                  | 0                     |
|    |  | 1300 5                    | 38                            | 11.9                   | 1023.0                  | 0                     |
|    |  | 1900 6                    | 62                            | 11.4                   | 1022.1                  | 0                     |
| 18 |  | 100 3                     | 64                            | 11.3                   | 1019.0                  | 0                     |
|    |  | 700 1                     | 75                            | 11.6                   | 1015.9                  | 0                     |
|    |  | 1300 2                    | 166                           | 13.0                   | 1010.2                  | 0                     |
|    |  | 1900 7                    | 297                           | 9.8                    | 1009.1                  | 0                     |
| 19 |  | 100 10                    | 312                           | 5.3                    | 1012.2                  | 0                     |
|    |  | 700 9                     | 285                           | 3.3                    | 1014.7                  | 0                     |
|    |  | 1300 6                    | 301                           | 9.4                    | 1014.8                  | 0                     |
|    |  | 1900 3                    | 302                           | 6.0                    | 1017.2                  | 5                     |
| 20 |  | 100 5                     | 19                            | 8.1                    | 1015.3                  | 0                     |
|    |  | 700 7                     | 29                            | 7.3                    | 1019.6                  | 0                     |
|    |  | 1300 5                    | 7                             | 8.3                    | 1020.5                  | 0                     |
|    |  | 1900 9                    | 22                            | 7.0                    | 1021.6                  | 0                     |
| 21 |  | 100 9                     | 26                            | 7.2                    | 1021.5                  | 0                     |
|    |  | 700 12                    | 6                             | 5.2                    | 1024.1                  | 0                     |
|    |  | 1300 11                   | 7                             | 6.5                    | 1025.8                  | 0                     |
|    |  | 1900 9                    | 16                            | 6.2                    | 1027.9                  | 0                     |
| 22 |  | 100 10                    | 11                            | 5.5                    | 1028.5                  | 0                     |
|    |  | 700 10                    | 16                            | 5.9                    | 1029.4                  | 0                     |
|    |  | 1300 8                    | 11                            | 8.3                    | 1029.9                  | 0                     |
|    |  | 1900 5                    | 33                            | 7.7                    | 1029.4                  | 0                     |
| 23 |  | 100 3                     | 340                           | 4.0                    | 1028.0                  | 0                     |
|    |  | 700 5                     | 22                            | 8.4                    | 1026.5                  | 0                     |
|    |  | 1300 4                    | 28                            | 10.4                   | 1024.3                  | 0                     |
|    |  | 1900 4                    | 21                            | 9.6                    | 1022.6                  | 0                     |
| 24 |  | 100 4                     | 60                            | 10.6                   | 1019.5                  | 0                     |
|    |  | 700 6                     | 87                            | 11.6                   | 1017.0                  | 0                     |
|    |  | 1300 9                    | 130                           | 12.5                   | 1009.6                  | 0                     |
|    |  | 1900 11                   | 134                           | 14.4                   | 1004.2                  | 13                    |
| 25 |  | 100 3                     | 234                           | 11.8                   | 1007.8                  | 5                     |
|    |  | 700 3                     | 232                           | 9.4                    | 1011.1                  | 0                     |
|    |  | 1300 5                    | 245                           | 12.4                   | 1012.5                  | 0                     |
|    |  | 1900 5                    | 252                           | 10.7                   | 1015.8                  | 0                     |
| 26 |  | 100 4                     | 280                           | 8.9                    | 1017.3                  | 0                     |
|    |  | 700 6                     | 10                            | 8.8                    | 1020.0                  | 0                     |
|    |  | 1300 9                    | 1                             | 8.1                    | 1020.2                  | 0                     |
|    |  | 1900 9                    | 26                            | 7.4                    | 1022.2                  | 0                     |
| 27 |  | 100 8                     | 25                            | 6.5                    | 1023.4                  | 0                     |
|    |  | 700 10                    | 11                            | 6.4                    | 1024.6                  | 0                     |
|    |  | 1300 10                   | 6                             | 7.3                    | 1023.7                  | 0                     |
|    |  | 1900 10                   | 11                            | 7.2                    | 1023.0                  | 0                     |
| 28 |  | 100 13                    | 7                             | 7.3                    | 1020.9                  | 0                     |
|    |  | 700 11                    | 358                           | 6.7                    | 1021.6                  | 0                     |
|    |  | 1300 12                   | 0                             | 6.0                    | 1023.2                  | 0                     |
|    |  | 1900 10                   | 8                             | 5.4                    | 1024.6                  | 0                     |
| 29 |  | 100 9                     | 14                            | 5.0                    | 1024.3                  | 0                     |
|    |  | 700 9                     | 20                            | 5.7                    | 1024.9                  | 0                     |
|    |  | 1300 7                    | 353                           | 7.5                    | 1023.3                  | 0                     |
|    |  | 1900 5                    | 19                            | 6.7                    | 1021.1                  | 0                     |
| 30 |  | 100 7                     | 9                             | 7.5                    | 1015.8                  | 0                     |
|    |  | 700 6                     | 319                           | 5.6                    | 1012.1                  | 0                     |
|    |  | 1300 *                    |                               |                        | 1007.7                  | 0                     |
|    |  | 1900 9                    | 314                           | 6.8                    | 1013.8                  | 0                     |
| 31 |  | 100 6                     | 311                           | 4.1                    | 1018.2                  | 0                     |
|    |  | 700 6                     | 310                           | 2.7                    | 1020.9                  | 0                     |
|    |  | 1300 4                    | 344                           | 6.1                    | 1024.3                  | 0                     |
|    |  | 1900 6                    | 35                            | 6.0                    | 1026.3                  | 0                     |

\*=Electronic problems

### III. WAVE DATA

Wave data were collected from two Baylor staff gages (CERC gage Nos. 625 and 645) and Waverider buoys (CERC gage Nos. 630 and 640, Table 1 and Figure 2). The data were collected, analyzed, and stored on magnetic tape using a Data General NOVA-4 computer.

The NOVA-4 is programmed to sample the wave gages every 6 hours near 0100, 0700, 1300, and 1900 EST at a sampling rate of four times per second, collecting data in 20- minute records.

Wave height ( $H_{mo}$ ) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. The wave period is identified from the computation of a variance (energy) spectrum using a Fast Fourier Transform of 4096 data points (1024 sec). The period ( $T_p$ ) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape and entered into the CERC data base.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means shown in Table 3 are an average of the values computed for all data records collected. The monthly standard deviations are standard deviations from the monthly mean of values for each record.

Figure 3 is a time history of the  $H_{mo}$  and  $T_p$  values for the Waveriders, 6 km from shore (630) and 1 km from shore (640).

Differences in wave periods between wave gages (Table 4 and Figure 3) may be due to wave breaking or reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

PART 1

DECEMBER 1986

| GAGE | DAY | TIME | 645    |                   | 625    |                    | 640     |                 | 630    |                 |
|------|-----|------|--------|-------------------|--------|--------------------|---------|-----------------|--------|-----------------|
|      |     |      | Baylor | at 7+80<br>Hmo(m) | Baylor | at 19+00<br>Hmo(m) | Nearshr | Wvrdt<br>Hmo(m) | Farshr | Wvrdt<br>Hmo(m) |
|      |     |      | T(sec) |                   | T(sec) |                    | T(sec)  |                 | T(sec) |                 |
|      | 1   | 1    | .85    | 6.40              | 2.11   | 6.87               | 2.41    | 6.40            | 2.46   | 6.40            |
|      |     | 7    | 1.51   | 8.06              | 2.66   | 6.87               | 3.01    | 7.42            | 3.54   | 8.06            |
|      |     | 13   | .98    | 8.83              | 2.83   | 8.83               | *       |                 | 3.25   | 8.06            |
|      |     | 19   | 1.47   | 8.83              | 2.97   | 9.75               | 3.63    | 8.83            | 3.63   | 8.83            |
|      | 2   | 1    | 1.23   | 8.83              | 2.76   | 9.75               | *       |                 | 3.43   | 8.83            |
|      |     | 7    | 1.75   | 9.75              | 3.13   | 9.75               |         |                 | 3.61   | 9.75            |
|      |     | 13   | 1.14   | 10.89             | 2.92   | 10.89              |         |                 | 4.23   | 10.89           |
|      |     | 19   | 1.53   | 10.89             | 2.84   | 10.89              |         |                 | 3.58   | 12.34           |
|      | 3   | 1    | 1.30   | 12.34             | 2.50   | 10.89              | 2.95    | 10.89           | 2.79   | 10.89           |
|      |     | 7    | 1.83   | 8.83              | 2.34   | 10.89              | 2.52    | 10.89           | 2.94   | 10.89           |
|      |     | 13   | 1.29   | 8.83              | 1.28   | 9.75               | 1.42    | 10.89           | 1.76   | 10.89           |
|      |     | 19   | 1.46   | 10.89             | 1.24   | 10.89              | 1.54    | 9.75            | 1.49   | 10.89           |
|      | 4   | 1    | .90    | 9.75              | .80    | 10.89              | .96     | 9.75            | 1.16   | 10.89           |
|      |     | 7    | .68    | 8.83              | .87    | 9.75               |         |                 | .97    | 9.75            |
|      |     | 13   | .50    | 9.75              | .69    | 9.75               |         |                 | .83    | 9.75            |
|      |     | 19   | .46    | 9.75              | .70    | 9.75               |         |                 | .88    | 9.75            |
|      | 5   | 1    | .39    | 9.75              | .60    | 8.83               |         |                 | .67    | 9.75            |
|      |     | 7    | .64    | 3.64              | .78    | 3.79               |         |                 | .88    | 8.83            |
|      |     | 13   | .68    | 5.31              | .95    | 6.40               |         |                 | 1.10   | 8.83            |
|      |     | 19   | .75    | 4.53              | .98    | 5.63               |         |                 | 1.18   | 8.83            |
|      | 6   | 1    | .83    | 5.31              | 1.13   | 5.31               |         |                 | 1.23   | 5.99            |
|      |     | 7    | .71    | 4.53              | .93    | 5.99               |         |                 | 1.09   | 5.63            |
|      |     | 13   | .56    | 5.02              | .76    | 14.22              |         |                 | .92    | 5.31            |
|      |     | 19   | .48    | 4.32              | .68    | 5.31               |         |                 | .82    | 5.31            |
|      | 7   | 1    | .39    | 8.06              | .57    | 14.22              |         |                 | .75    | 5.02            |
|      |     | 7    | .38    | 14.22             | .49    | 14.22              |         |                 | .62    | 8.83            |
|      |     | 13   | .35    | 8.83              | .48    | 8.06               |         |                 | .54    | 8.83            |
|      |     | 19   | .35    | 6.87              | .46    | 12.34              |         |                 | .54    | 8.06            |
|      | 8   | 1    | .39    | 8.83              | .46    | 8.06               |         |                 | .55    | 8.83            |
|      |     | 7    | .26    | 5.99              | .30    | 9.75               |         |                 | .46    | 7.42            |
|      |     | 13   | .28    | 9.75              | .33    | 9.75               |         |                 | .44    | 8.83            |
|      |     | 19   | .25    | 10.89             | .32    | 8.06               |         |                 | .55    | 8.83            |
|      | 9   | 1    | .42    | 8.06              | .46    | 8.06               |         |                 | .64    | 8.83            |
|      |     | 7    | .39    | 8.83              | .50    | 8.06               |         |                 | .59    | 9.75            |
|      |     | 13   | .55    | 9.75              | .61    | 9.75               |         |                 | .72    | 9.75            |
|      |     | 19   | .75    | 6.87              | .71    | 9.75               |         |                 | 1.08   | 5.99            |
|      | 10  | 1    | .86    | 5.99              | .74    | 5.99               |         |                 | 1.40   | 6.40            |
|      |     | 7    | .71    | 6.40              | .67    | 9.75               |         |                 | 1.28   | 6.87            |
|      |     | 13   | .64    | 6.87              | .55    | 9.75               |         |                 | *      |                 |
|      |     | 19   | .43    | 9.75              | .46    | 8.83               |         |                 |        |                 |
|      | 11  | 1    | .61    | 2.95              | .66    | 3.05               |         |                 | 1.26   | 4.76            |
|      |     | 7    | 1.16   | 5.63              | 1.61   | 5.99               |         |                 | 1.72   | 5.99            |
|      |     | 13   | 1.10   | 6.87              | 1.55   | 6.87               |         |                 | 1.37   | 8.06            |
|      |     | 19   | .83    | 5.63              | 1.25   | 5.99               |         |                 | 1.23   | 10.89           |
|      | 12  | 1    | .73    | 6.40              | 1.07   | 6.40               |         |                 | 1.23   | 7.42            |
|      |     | 7    | .57    | 5.99              | .76    | 7.42               |         |                 | 1.13   | 8.06            |
|      |     | 13   | .38    | 6.87              | .70    | 6.87               |         |                 | 1.17   | 6.40            |
|      |     | 19   | .49    | 9.75              | .67    | 8.06               |         |                 | 2.04   | 8.83            |
|      | 13  | 1    | .82    | 4.13              | 1.01   | 4.13               |         |                 | 1.31   | 10.89           |
|      |     | 7    | .85    | 5.99              | 1.22   | 6.40               |         |                 | *      |                 |
|      |     | 13   | 1.26   | 5.99              | 1.68   | 7.42               |         |                 | 1.73   | 4.32            |
|      |     | 19   | 1.22   | 5.63              | 1.45   | 6.87               |         |                 | 1.38   | 5.31            |
|      | 14  | 1    | .83    | 4.76              | 1.09   | 6.87               |         |                 | 1.40   | 6.40            |
|      |     | 7    | .68    | 5.31              | .95    | 6.87               |         |                 | 1.46   | 7.42            |
|      |     | 13   | .60    | 3.51              | .81    | 6.87               |         |                 |        |                 |
|      |     | 19   | .36    | 8.83              | .65    | 8.06               |         |                 |        |                 |
|      | 15  | 1    | .26    | 20.48             | .49    | 8.83               |         |                 |        |                 |
|      |     | 7    | .31    | 9.75              | .42    | 9.75               |         |                 |        |                 |
|      |     | 13   | .24    | 9.75              | .40    | 9.75               |         |                 |        |                 |
|      |     | 19   | .33    | 9.75              | .42    | 8.83               |         |                 |        |                 |
|      | 16  | 1    | .30    | 10.89             | .47    | 9.75               |         |                 |        |                 |
|      |     | 7    | .38    | 10.89             | .47    | 8.83               |         |                 |        |                 |
|      |     | 13   | .34    | 9.75              | .46    | 9.75               |         |                 |        |                 |
|      |     | 19   | .45    | 9.75              | .55    | 10.89              |         |                 |        |                 |

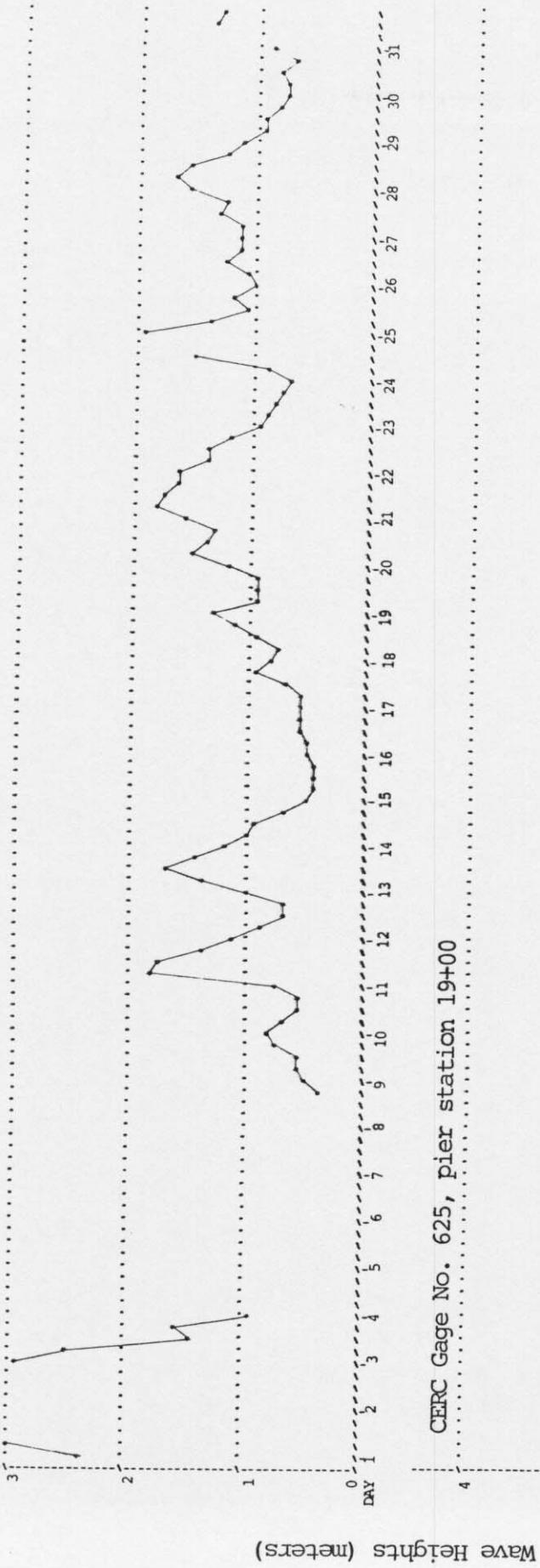
TABLE 3: WAVE DATA

PART 2

DECEMBER 1986

| GAGE |      | 645    |                   | 625    |                    | 640     |                | 630    |                |
|------|------|--------|-------------------|--------|--------------------|---------|----------------|--------|----------------|
| DAY  | TIME | Baylor | at 7+80<br>Hmo(m) | Baylor | at 19+00<br>Hmo(m) | Nearsho | Wvrd<br>Hmo(m) | Farsho | Wvrd<br>Hmo(m) |
|      |      |        | T(sec)            |        | T(sec)             |         | T(sec)         |        | T(sec)         |
| 17   | 1    | .39    | 10.89             | .52    | 9.75               | .58     | 9.75           |        |                |
|      | 7    | .43    | 10.89             | .53    | 10.89              | .58     | 9.75           |        |                |
|      | 13   | .59    | 3.26              | .74    | 4.32               | .68     | 4.32           |        |                |
|      | 19   | .67    | 4.76              | .91    | 4.76               | .95     | 4.76           |        |                |
|      | 1    | .54    | 3.51              | .77    | 4.32               | .80     | 4.32           |        |                |
|      | 7    | .53    | 5.63              | .79    | 5.31               | .78     | 5.31           |        |                |
|      | 13   | .42    | 9.75              | .85    | 8.06               | .95     | 8.06           |        |                |
|      | 19   | .73    | 5.63              | 1.08   | 8.06               | 1.15    | 6.87           |        |                |
|      | 1    | 1.10   | 5.99              | 1.26   | 5.99               | 1.33    | 5.02           |        |                |
|      | 7    | .63    | 5.63              | .82    | 6.40               | .93     | 6.87           |        |                |
| 18   | 13   | .73    | 4.13              | .90    | 14.22              | .93     | 14.22          |        |                |
|      | 19   | .63    | 14.22             | .88    | 12.34              | .93     | 12.34          |        |                |
|      | 1    | .86    | 5.02              | 1.17   | 14.22              | 1.19    | 8.83           |        |                |
|      | 7    | .94    | 5.31              | 1.43   | 10.89              | 1.51    | 10.89          |        |                |
|      | 13   | .84    | 16.79             | 1.27   | 14.22              | 1.38    | 14.22          |        |                |
|      | 19   | .81    | 14.22             | 1.25   | 14.22              | 1.31    | 12.34          |        |                |
|      | 20   | 1      | 1.01              | 14.22  | 1.42               | 10.89   | 1.53           | 12.34  |                |
|      | 7    | 1.20   | 4.32              | 1.65   | 14.22              | 1.80    | 14.22          |        |                |
|      | 13   | 1.27   | 5.63              | 1.76   | 5.63               | 1.73    | 14.22          |        |                |
|      | 19   | 1.07   | 4.76              | 1.60   | 12.34              | 1.65    | 12.34          |        |                |
| 21   | 1    | 1.05   | 4.76              | 1.45   | 12.34              | 1.60    | 6.87           |        |                |
|      | 7    | .97    | 5.31              | 1.41   | 12.34              | 1.40    | 10.89          |        |                |
|      | 13   | .89    | 5.31              | 1.33   | 6.40               | 1.35    | 10.89          |        |                |
|      | 19   | .71    | 3.26              | 1.09   | 10.89              | 1.17    | 10.89          |        |                |
|      | 1    | .54    | 5.63              | .93    | 9.75               | .97     | 9.75           |        |                |
|      | 7    | .44    | 14.22             | *      |                    | .88     | 10.89          |        |                |
|      | 13   | .55    | 5.63              | .81    | 8.06               | .84     | 8.83           |        |                |
|      | 19   | *      |                   | .72    | 10.89              | .76     | 10.89          |        |                |
|      | 1    | .56    | 4.53              | .69    | 4.53               | .71     | 8.83           |        |                |
|      | 7    | .96    | 6.40              | .87    | 5.99               | .85     | 5.99           |        |                |
| 22   | 13   | 1.48   | 8.06              | 1.49   | 8.06               | 1.49    | 7.42           |        |                |
|      | 19   | 1.45   | 8.83              | 2.53   | 8.83               | 3.02    | 9.75           |        |                |
|      | 1    | 1.64   | 12.34             | 1.88   | 10.89              | 1.94    | 10.89          |        |                |
|      | 7    | 1.25   | 10.89             | 1.33   | 10.89              | 1.36    | 10.89          |        |                |
|      | 13   | 1.38   | 10.89             | 1.10   | 10.89              | 1.03    | 9.75           |        |                |
|      | 19   | 1.11   | 9.75              | .97    | 9.75               | 1.16    | 9.75           |        |                |
|      | 1    | 1.12   | 9.75              | .92    | 9.75               | .99     | 8.83           |        |                |
|      | 7    | .91    | 9.75              | .98    | 9.75               | 1.04    | 8.83           |        |                |
|      | 13   | 1.02   | 9.75              | 1.17   | 9.75               | 1.27    | 9.75           |        |                |
|      | 19   | .86    | 8.83              | 1.07   | 8.83               | 1.10    | 9.75           |        |                |
| 23   | 1    | .84    | 8.06              | 1.06   | 8.06               | 1.13    | 5.02           |        |                |
|      | 7    | .85    | 3.79              | 1.10   | 5.31               | 1.14    | 5.63           |        |                |
|      | 13   | .89    | 5.31              | 1.22   | 5.31               | 1.29    | 5.31           |        |                |
|      | 19   | .87    | 5.63              | 1.27   | 5.63               | 1.24    | 5.63           |        |                |
|      | 1    | 1.04   | 5.63              | 1.49   | 5.31               | 1.56    | 6.40           |        |                |
|      | 7    | 1.16   | 6.40              | 1.56   | 6.40               | 1.67    | 6.40           |        |                |
|      | 13   | 1.08   | 5.99              | 1.59   | 6.40               | 1.58    | 6.40           |        |                |
|      | 19   | .91    | 5.31              | 1.16   | 6.40               | 1.25    | 6.40           |        |                |
|      | 1    | .87    | 5.31              | 1.15   | 4.76               | 1.12    | 5.63           |        |                |
|      | 7    | .69    | 5.02              | .96    | 7.42               | .92     | 5.31           |        |                |
| 24   | 13   | .82    | 3.38              | .92    | 7.42               | .94     | 9.75           |        |                |
|      | 19   | .62    | 8.06              | .81    | 8.06               | .84     | 9.75           |        |                |
|      | 1    | .62    | 8.83              | .71    | 8.06               | .74     | 8.06           |        |                |
|      | 7    | .50    | 6.40              | .74    | 8.83               | .76     | 8.83           |        |                |
|      | 13   | .79    | 4.76              | .83    | 5.02               | .78     | 4.76           |        |                |
|      | 19   | .64    | 9.75              | .71    | 8.83               | .69     | 9.75           |        |                |
|      | 1    | .88    | 4.76              | .86    | 5.99               | .89     | 5.63           |        |                |
|      | 7    |        |                   | .46    | 8.83               | *       |                |        |                |
|      | 13   | 1.00   | 6.40              | 1.55   | 9.75               | 1.38    | 8.83           |        |                |
|      | 19   | .84    | 5.02              | 1.26   | 10.89              | 1.32    | 9.75           |        |                |
| MEAN |      | .81    | 7.69              | 1.09   | 8.61               | 1.15    | 8.52           | 1.56   | 8.13           |
| STD  |      | .41    | 3.05              | .62    | 2.58               | .59     | 2.45           | .99    | 2.04           |

CERC Gage No. 640, Waverider, 1 km from shore



CERC Gage No. 625, pier station 19+00

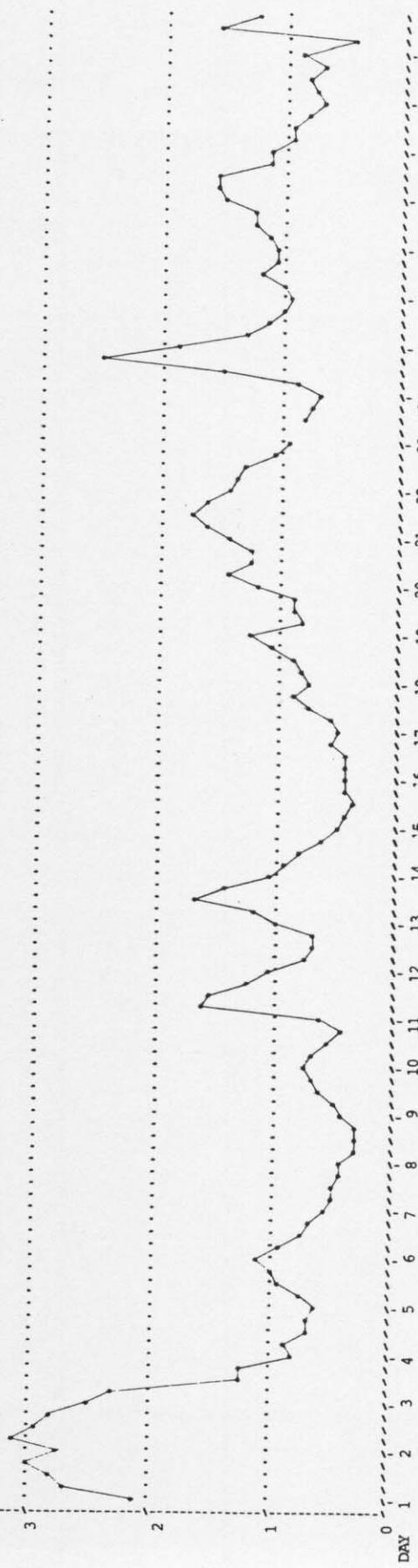
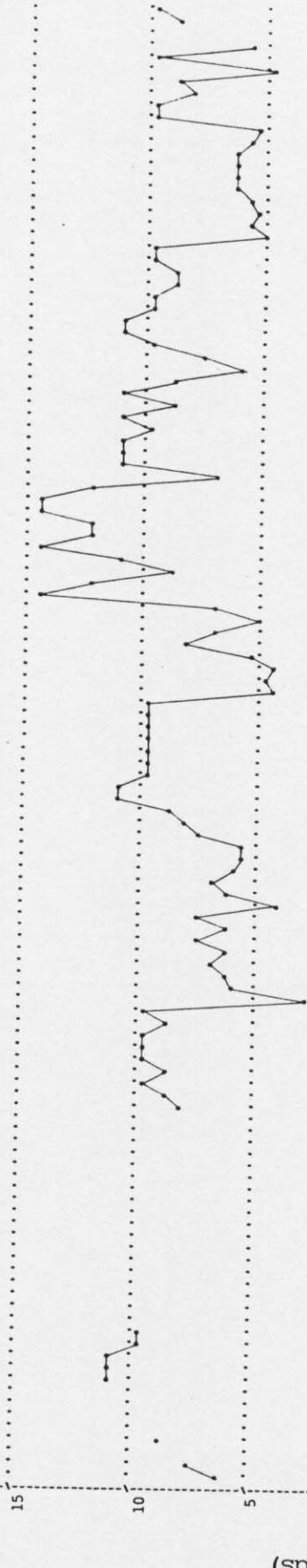


FIGURE 3. Time History of Wave Heights and Periods - December 1986  
Part I: Heights

CERC Gage No. 640, Waverider 1 km from shore

20



CERC Gage No. 625, pier station 19+00

13

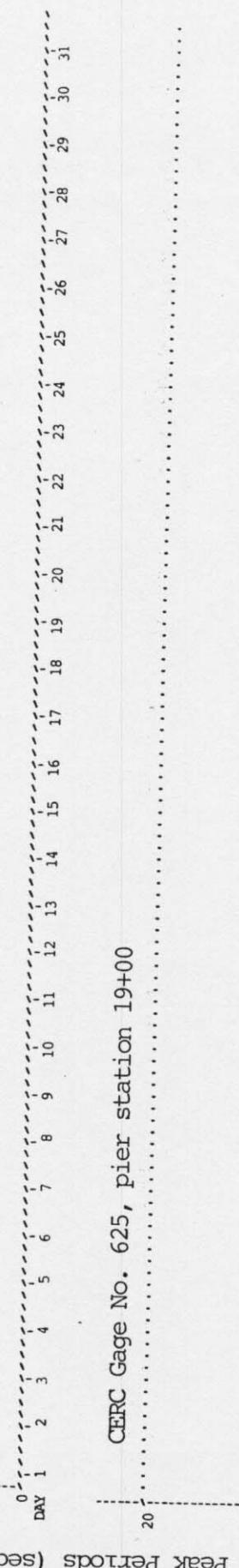


FIGURE 3. Time History of Wave Heights and Periods - December 1987

Part II: Periods



Part III: Periods

#### IV. CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: CURRENT DATA  
(SPEEDS IN CM/SEC)

December 1986

| DAY: | TIME            | PIER MEASUREMENTS                      |                                   |  | BEACH MEASUREMENTS:<br>(500' UPWRTY) |                                   |           | CURRENT METER   |     |
|------|-----------------|--|-----------------------------------|--|--------------------------------------|-----------------------------------|-----------|-----------------|-----|
|      |                 | DYE AT<br>19+00<br>(579m)<br>(SURFACE) | DYE AT MIN-SURF ZONE<br>(SURFACE) | 12M OFFSHORE<br>DIST. FRM<br>(SURFACE) | INL                                  | 12M OFFSHORE<br>(DEPTH -4.8M MSL) | I.D. #679 | AT SOUTH TRIFID |     |
| 1    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 40              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 7               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 41              | 150 |
| 1    | 0700-Alongshore | 36 S                                   |                                   | 102 S                                  |                                      |                                   |           | 43              | S   |
|      | Cross-shore     | 36 On                                  |                                   | 301 91 On                              | No Reading                           |                                   |           | 11              | OF  |
|      | Resultant       | 51 205                                 |                                   | 137 202                                |                                      |                                   |           | 44              | 146 |
| 1    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 55              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 13              | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 57              | 147 |
| 1    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 50              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 13              | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 52              | 145 |
| 2    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 27              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 11              | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 29              | 137 |
| 2    | 0700-Alongshore | 38 N                                   |                                   | 87 N                                   |                                      | 41 N                              |           | 22              | N   |
|      | Cross-shore     | 11 On                                  |                                   | 201 0 0                                | South                                |                                   |           | 4               | OF  |
|      | Resultant       | 40 323                                 |                                   | 87 340                                 |                                      |                                   |           | 22              | 350 |
| 2    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 79              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 13              | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 80              | 349 |
| 2    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 56              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 6               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 57              | 342 |
| 3    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 34              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 6               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 34              | 350 |
| 3    | 0700-Alongshore | 0 0                                    |                                   | 76 N                                   |                                      | 111 N                             |           | 2               | S   |
|      | Cross-shore     | 36 Off                                 |                                   | 164 0 0                                | South                                |                                   |           | 5               | ON  |
|      | Resultant       | 36 70                                  |                                   | 76 340                                 |                                      |                                   |           | 5               | 226 |
| 3    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 1               | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 1               | ON  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 1               | 305 |
| 3    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 13              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 2               | ON  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 13              | 333 |
| 4    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 11              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 0               |     |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 11              | 340 |
| 4    | 0700-Alongshore | 0 0                                    |                                   | 0 0                                    |                                      | 17 S                              |           | 17              | N   |
|      | Cross-shore     | 6 Off                                  |                                   | 140 11 Off                             | North                                |                                   |           | 2               | ON  |
|      | Resultant       | 6 115                                  |                                   | 11 97                                  |                                      |                                   |           | 17              | 332 |
| 4    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 4               | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 3               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 5               | 17  |
| 4    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 16              | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 0               |     |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 16              | 340 |
| 5    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 7               | N   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 0               |     |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 7               | 340 |
| 5    | 0700-Alongshore | 8 S                                    |                                   |  |                                      |                                   |           | 6               | N   |
|      | Cross-shore     | 5 On                                   |                                   |  |                                      |                                   |           | 1               | OF  |
|      | Resultant       | 10 193                                 |                                   |  |                                      |                                   |           | 6               | 347 |
| 5    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 7               | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 6               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 10              | 120 |
| 5    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 4               | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 3               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 5               | 124 |
| 6    | 0100-Alongshore |  |                                   |  |                                      |                                   |           | 16              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 4               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 16              | 147 |
| 6    | 0700-Alongshore | 20 S                                   |                                   | 34 S                                   |                                      |                                   |           | 9               | S   |
|      | Cross-shore     | 10 On                                  |                                   | 164 8 On                               | No Reading                           |                                   |           | 4               | OF  |
|      | Resultant       | 23 187                                 |                                   | 35 174                                 |                                      |                                   |           | 10              | 137 |
| 6    | 1300-Alongshore |  |                                   |  |                                      |                                   |           | 15              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 3               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 15              | 148 |
| 6    | 1900-Alongshore |  |                                   |  |                                      |                                   |           | 11              | S   |
|      | Cross-shore     |  |                                   |  |                                      |                                   |           | 2               | OF  |
|      | Resultant       |  |                                   |  |                                      |                                   |           | 11              | 148 |

KEY = ALL SPEEDS IN CM/SEC  
N = NORTHWARD, SHORE PARALLEL  
S = SOUTHWARD, SHORE PARALLEL  
ON=ONSHORE  
OF=OFFSHORE

| DAY | TIME            | PIER MEASUREMENTS                      |                                   |  | BEACH MEASUREMENTS<br>(500' UPDRIFT) |           |           | CURRENT METER<br>AT SOUTH TRIPOD<br>(DEPTH -4.8m MSL)<br>I.D. #679 |
|-----|-----------------|--|-----------------------------------|--|--------------------------------------|-----------|-----------|--|
|     |                 | DYE AT<br>19400<br>(579m)<br>(SURFACE) | DYE AT MID-SURF ZONE<br>(SURFACE) | DYE<br>DIST. FROM<br>12M OFFSHORE<br>(SURFACE) | LOCATION                             | SPEED DIR | DIR       |  |
|     |                 |  |                                   | BASELINE(M)                                    | SPEED DIR                            | LOCATION  | SPEED DIR | SPEED DIR  |
| 7   | 0100-Alongshore |  |                                   |  |                                      |           |           |  |
|     | Cross-shore     |  |                                   |  |                                      |           | 5         | OF   |
|     | Resultant       |  |                                   |  |                                      |           | 12        | 132  |
| 7   | 0700-Alongshore | 29 S                                   |                                   |  |                                      |           |           |  |
|     | Cross-shore     | 17 On                                  |                                   | 164  | 4 N                                  | South     | 0 0       |  |
|     | Resultant       | 34 191                                 |                                   |  | 0 0                                  |           | 5         | OF   |
| 7   | 1300-Alongshore |  |                                   |  |                                      |           |           |  |
|     | Cross-shore     |  |                                   |  |                                      |           | 12        | S  |
|     | Resultant       |  |                                   |  |                                      |           | 3         | OF   |
| 7   | 1900-Alongshore |  |                                   |  |                                      |           | 12        | 144  |
|     | Cross-shore     |  |                                   |  |                                      |           | 4         | S  |
|     | Resultant       |  |                                   |  |                                      |           | 5         | OF   |
| 8   | 0100-Alongshore |  |                                   |  |                                      |           | 7         | 108  |
|     | Cross-shore     |  |                                   |  |                                      |           | 0         |  |
|     | Resultant       |  |                                   |  |                                      |           | 1         | OF   |
| 8   | 0700-Alongshore | 13 N                                   |                                   |  |                                      |           | 1         | 70   |
|     | Cross-shore     | 3 Off                                  |                                   | 152  | 7 N                                  | South     | 8 N       |  |
|     | Resultant       | 14 354                                 |                                   |  | 5 Off                                |           | 1         | OF   |
| 8   | 1300-Alongshore |  |                                   |  |                                      |           | 7         | 346  |
|     | Cross-shore     |  |                                   |  |                                      |           | 9         | N  |
|     | Resultant       |  |                                   |  |                                      |           | 3         | OF   |
| 8   | 1900-Alongshore |  |                                   |  |                                      |           | 9         | 357  |
|     | Cross-shore     |  |                                   |  |                                      |           | 3         | N  |
|     | Resultant       |  |                                   |  |                                      |           | 2         | OF   |
| 9   | 0100-Alongshore |  |                                   |  |                                      |           | 4         | 15   |
|     | Cross-shore     |  |                                   |  |                                      |           | 1         | N  |
|     | Resultant       |  |                                   |  |                                      |           | 0         |  |
| 9   | 0700-Alongshore | 15 N                                   |                                   |  |                                      |           | 1         | 340  |
|     | Cross-shore     | 4 Off                                  |                                   | 152  | 44 N                                 | South     | 19 N      |  |
|     | Resultant       | 15 357                                 |                                   |  | 7 Off                                |           | 5         | S  |
| 9   | 1300-Alongshore |  |                                   |  |                                      |           | 5         | 160  |
|     | Cross-shore     |  |                                   |  |                                      |           | 2         | N  |
|     | Resultant       |  |                                   |  |                                      |           | 0         |  |
| 9   | 1900-Alongshore |  |                                   |  |                                      |           | 2         | 340  |
|     | Cross-shore     |  |                                   |  |                                      |           | 4         | N  |
|     | Resultant       |  |                                   |  |                                      |           | 3         | OF   |
| 10  | 0100-Alongshore |  |                                   |  |                                      |           | 5         | 11   |
|     | Cross-shore     |  |                                   |  |                                      |           | 1         | S  |
|     | Resultant       |  |                                   |  |                                      |           | 5         | OF   |
| 10  | 0700-Alongshore | 6 N                                    |                                   |  |                                      |           | 5         | 80   |
|     | Cross-shore     | 10 Off                                 |                                   | 155  | 44 N                                 | South     | 20 N      |  |
|     | Resultant       | 12 41                                  |                                   |  | 7 On                                 |           | 3         | S  |
| 10  | 1300-Alongshore |  |                                   |  |                                      |           | 4         | OF   |
|     | Cross-shore     |  |                                   |  |                                      |           | 5         | 113  |
|     | Resultant       |  |                                   |  |                                      |           | 14        | S  |
| 10  | 1900-Alongshore |  |                                   |  |                                      |           | 6         | OF   |
|     | Cross-shore     |  |                                   |  |                                      |           | 15        | 138  |
|     | Resultant       |  |                                   |  |                                      |           | 6         | S  |
|     | Resultant       |  |                                   |  |                                      |           | 4         | ON   |
| 11  | 0100-Alongshore |  |                                   |  |                                      |           | 7         | 123  |
|     | Cross-shore     |  |                                   |  |                                      |           | 3         | S  |
|     | Resultant       |  |                                   |  |                                      |           | 6         | ON   |
| 11  | 0700-Alongshore | 34 S                                   |                                   |  |                                      |           | 7         | 221  |
|     | Cross-shore     | 0 0                                    |                                   | 261  | 76 S                                 | North     | 52 S      |  |
|     | Resultant       | 34 160                                 |                                   |  | 0 0                                  |           | 25        | ON   |
| 11  | 1300-Alongshore |  |                                   |  |                                      |           | 25        | 331  |
|     | Cross-shore     |  |                                   |  |                                      |           | 21        | N  |
|     | Resultant       |  |                                   |  |                                      |           | 2         | ON   |
| 11  | 1900-Alongshore |  |                                   |  |                                      |           | 21        | 334  |
|     | Cross-shore     |  |                                   |  |                                      |           | 27        | N  |
|     | Resultant       |  |                                   |  |                                      |           | 2         | ON   |
| 12  | 0100-Alongshore |  |                                   |  |                                      |           | 27        | 336  |
|     | Cross-shore     |  |                                   |  |                                      |           | 13        | N  |
|     | Resultant       |  |                                   |  |                                      |           | 1         | ON   |
| 12  | 0700-Alongshore | 28 S                                   |                                   |  |                                      |           | 13        | 335  |
|     | Cross-shore     | 7 Off                                  |                                   | 175  | 12 S                                 |           | 18        | N  |
|     | Resultant       | 29 145                                 |                                   |  | 25 Off                               | North     | 5         | ON   |
| 12  | 1300-Alongshore |  |                                   |  |                                      |           | 28        | 94   |
|     | Cross-shore     |  |                                   |  |                                      |           | 18        | 323  |
|     | Resultant       |  |                                   |  |                                      |           | 6         | N  |
| 12  | 1900-Alongshore |  |                                   |  |                                      |           | 1         | ON   |
|     | Cross-shore     |  |                                   |  |                                      |           | 15        | 333  |
|     | Resultant       |  |                                   |  |                                      |           | 6         | ON   |
|     | Resultant       |  |                                   |  |                                      |           | 15        | 340  |

KEY = ALL SPEEDS IN CM/SEC  
 N =NORTHWARD, SHORE PARALLEL  
 S =SOUTHWARD, SHORE PARALLEL  
 ON=ONSHORE  
 OF=OFFSHORE

| DAY: | TIME            | PIER MEASUREMENTS                      |  |                                  | BEACH MEASUREMENTS<br>(500' UPDRIFT) |            |    | CURRENT METER<br>AT SOUTH TRIFOD<br>(DEPTH -4.8m MSL)<br>I.D. #679 |
|------|-----------------|--|--|----------------------------------|--------------------------------------|------------|----|--|
|      |                 | DYE AT<br>19+00<br>(579m)<br>(SURFACE) | DYE AT MID-SURF ZONE<br>(SURFACE)<br>DIST. FROM<br>BASELINE(M) | DYE<br>12M OFFSHORE<br>(SURFACE) | LOCATION:<br>SPEED(DIR)              | SPEED(DIR) |    |  |
| 13   | 0100-Alongshore |  |  |                                  |                                      |            | 15 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 2  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 16 | 332  |
| 13   | 0700-Alongshore | 68 S                                   |  | 102 S                            |                                      |            | 15 | N  |
|      | Cross-shore     | 3 On                                   |  | 0 0                              | No Reading                           |            | 0  |  |
|      | Resultant       | 68 163                                 |  | 102 160                          |                                      |            | 15 | 340  |
| 13   | 1300-Alongshore |  |  |                                  |                                      |            | 47 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 4  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 47 | 335  |
| 13   | 1900-Alongshore |  |  |                                  |                                      |            | 36 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 3  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 37 | 335  |
| 14   | 0100-Alongshore |  |  |                                  |                                      |            | 14 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 3  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 14 | 322  |
| 14   | 0700-Alongshore | 17 S                                   |  | 51 S                             |                                      |            | 14 | N  |
|      | Cross-shore     | 4 On                                   |  | 5 On                             | North                                | 25 S       | 3  | ON   |
|      | Resultant       | 18 174                                 |  | 51 166                           |                                      |            | 14 | 329  |
| 14   | 1300-Alongshore |  |  |                                  |                                      |            | 1  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 4  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 4  | 265  |
| 14   | 1900-Alongshore |  |  |                                  |                                      |            | 5  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 4  | OF   |
| 15   | 0100-Alongshore |  |  |                                  |                                      |            | 7  | 14   |
|      | Cross-shore     |  |  |                                  |                                      |            | 10 | S  |
|      | Resultant       |  |  |                                  |                                      |            | 0  |  |
| 15   | 0700-Alongshore | 2 S                                    |  | 0 0                              |                                      |            | 10 | 160  |
|      | Cross-shore     | 4 Off                                  |  | 10 Off                           |                                      |            | 2  | OF   |
|      | Resultant       | 4 98                                   |  | 10 70                            | North                                | 5 S        | 12 | 148  |
| 15   | 1300-Alongshore |  |  |                                  |                                      |            | 10 | S  |
|      | Cross-shore     |  |  |                                  |                                      |            | 2  | OF   |
|      | Resultant       |  |  |                                  |                                      |            | 10 | 151  |
| 15   | 1900-Alongshore |  |  |                                  |                                      |            | 9  | S  |
|      | Cross-shore     |  |  |                                  |                                      |            | 3  | OF   |
|      | Resultant       |  |  |                                  |                                      |            | 5  | S  |
| 16   | 0100-Alongshore |  |  |                                  |                                      |            | 2  | OF   |
|      | Cross-shore     |  |  |                                  |                                      |            | 10 | 132  |
|      | Resultant       |  |  |                                  |                                      |            | 10 | S  |
| 16   | 0700-Alongshore | 4 N                                    |  | 6 N                              |                                      |            | 10 | 147  |
|      | Cross-shore     | 4 On                                   |  | 3 On                             | South                                | 14 S       | 3  | OF   |
|      | Resultant       | 4 346                                  |  | 6 7                              |                                      |            | 10 | 145  |
| 16   | 1300-Alongshore |  |  |                                  |                                      |            | 5  | S  |
|      | Cross-shore     |  |  |                                  |                                      |            | 1  | OF   |
|      | Resultant       |  |  |                                  |                                      |            | 5  | 149  |
| 16   | 1900-Alongshore |  |  |                                  |                                      |            | 6  | S  |
|      | Cross-shore     |  |  |                                  |                                      |            | 2  | OF   |
|      | Resultant       |  |  |                                  |                                      |            | 7  | 142  |
| 17   | 0100-Alongshore |  |  |                                  |                                      |            | 4  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 0  |  |
|      | Resultant       |  |  |                                  |                                      |            | 4  | 340  |
| 17   | 0700-Alongshore | 32 S                                   |  | 10 S                             |                                      |            | 9  | N  |
|      | Cross-shore     | 10 Off                                 |  | 25 Off                           |                                      |            | 1  | ON   |
|      | Resultant       | 34 177                                 |  | 27 228                           | South                                | 13.7 S     | 9  | 334  |
| 17   | 1300-Alongshore |  |  |                                  |                                      |            | 7  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 0  |  |
|      | Resultant       |  |  |                                  |                                      |            | 7  | 340  |
| 17   | 1900-Alongshore |  |  |                                  |                                      |            | 11 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 0  |  |
|      | Resultant       |  |  |                                  |                                      |            | 11 | 340  |
| 18   | 0100-Alongshore |  |  |                                  |                                      |            | 9  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 1  | ON   |
|      | Resultant       |  |  |                                  |                                      |            | 9  | 332  |
| 18   | 0700-Alongshore | 17 S                                   |  | 7 S                              |                                      |            | 5  | N  |
|      | Cross-shore     | 0 0                                    |  | 2 Off                            |                                      |            | 7  | OF   |
|      | Resultant       | 17 160                                 |  | 7 143                            |                                      |            | 9  | 35   |
| 18   | 1300-Alongshore |  |  |                                  |                                      |            | 11 | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 0  |  |
|      | Resultant       |  |  |                                  |                                      |            | 11 | 340  |
| 18   | 1900-Alongshore |  |  |                                  |                                      |            | 4  | N  |
|      | Cross-shore     |  |  |                                  |                                      |            | 3  | OF   |
|      | Resultant       |  |  |                                  |                                      |            | 5  | 19   |

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 S =SOUTHWARD, SHORE PARALLEL  
 ON=ONSHORE  
 OF=OFFSHORE

| DAY: | TIME            | PIER MEASUREMENTS                      |   |                                   | BEACH MEASUREMENTS |           |  | CURRENT METER<br>AT SOUTH TRIPOD |
|------|-----------------|--|---|-----------------------------------|--------------------|-----------|--|----------------------------------|
|      |                 | DYE AT<br>19400<br>(579m)<br>(SURFACE) | DYE AT MIN-SURF ZONE<br>(SURFACE)<br>DIST. FROM | DYE<br>12M OFFSHORE<br>(SURI ACL) | DEPTH -4.8m MSL    | T.D. #679 |  |                                  |
| 19   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 19   | 0700-Alongshore | 9 S                                    |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 11 Off                                 |   |                                   |                    |           |  |                                  |
|      | Resultant       | 14 110                                 |   |                                   |                    |           |  |                                  |
| 19   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 19   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 20   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 20   | 0700-Alongshore | 22 S                                   |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 0 0                                    |   |                                   |                    |           |  |                                  |
|      | Resultant       | 22 160                                 |   |                                   |                    |           |  |                                  |
| 20   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 20   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 21   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 21   | 0700-Alongshore | 61 S                                   |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 0 0                                    |   |                                   |                    |           |  |                                  |
|      | Resultant       | 61 160                                 |   |                                   |                    |           |  |                                  |
| 21   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 21   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 22   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 22   | 0700-Alongshore | 141 S                                  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 83 On                                  |   |                                   |                    |           |  |                                  |
|      | Resultant       | 192 224                                |   |                                   |                    |           |  |                                  |
| 22   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 22   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 23   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 23   | 0700-Alongshore | 24 S                                   |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 0 0                                    |   |                                   |                    |           |  |                                  |
|      | Resultant       | 24 160                                 |   |                                   |                    |           |  |                                  |
| 23   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 23   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 24   | 0100-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 24   | 0700-Alongshore | 13 N                                   |   |                                   |                    |           |  |                                  |
|      | Cross-shore     | 3 Off                                  |   |                                   |                    |           |  |                                  |
|      | Resultant       | 13 354                                 |   |                                   |                    |           |  |                                  |
| 24   | 1300-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |
| 24   | 1900-Alongshore |  |   |                                   |                    |           |  |                                  |
|      | Cross-shore     |  |   |                                   |                    |           |  |                                  |
|      | Resultant       |  |   |                                   |                    |           |  |                                  |

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 N =NORTHWARD, SHORE PARALLEL  
 S =SOUTHWARD, SHORE PARALLEL  
 ON=ONSHORE  
 OF=OFFSHORE

| DAY | TIME            | PIER MEASUREMENTS                      |           |                                   | BEACH MEASUREMENTS<br>(500' OFFSHORE)       |                           |          | CURRENT METER<br>AT SOUTH TRIFID |            |     |
|-----|-----------------|--|-----------|-----------------------------------|---|---------------------------|----------|----------------------------------|------------|-----|
|     |                 | DYE AT<br>19400<br>(579m)<br>(SURFACE) | SPEED DIR | DYE AT MID-SURF ZONE<br>(SURFACE) | DYE AT<br>12M OFFSHORE<br>(DEPTH -4.8m MSL) | DIST. FROM<br>BASELINE(M) | LOCATION | SPEED DIR                        | SPEED DIR  | NIR |
| 25  | 0100-Alongshore |  |           |                                   |   |                           |          |                                  |            |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 12                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 12                               | OF         |     |
| 25  | 0700-Alongshore | 8                                      | N         |                                   |   | 87                        | N        | 32                               | N          | 17  |
|     | Cross-shore     | 4                                      | Off       |                                   |   | 176                       | 21       | Off                              | South      | 7   |
|     | Resultant       | 9                                      | 133       |                                   |   | 90                        | 354      |                                  |            | 1   |
| 25  | 1300-Alongshore |  |           |                                   |   |                           |          | 7                                | 351        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 1                                | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 6                                | OF         |     |
| 25  | 1900-Alongshore |  |           |                                   |   |                           |          | 6                                | 57         |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 11                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 5                                | DN         |     |
| 26  | 0100-Alongshore |  |           |                                   |   |                           |          | 12                               | 316        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 7                                | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | OF         |     |
| 26  | 0700-Alongshore | 68                                     | S         |                                   |   | 22                        | N        | 24                               | N          | 7   |
|     | Cross-shore     | 0                                      | 0         |                                   |   | 164                       | 5        | On                               | South      | 27  |
|     | Resultant       | 68                                     | 160       |                                   |   | 22                        | 326      |                                  |            | 15  |
| 26  | 1300-Alongshore |  |           |                                   |   |                           |          | 31                               | 311        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 24                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 0                                |            |     |
| 26  | 1900-Alongshore |  |           |                                   |   |                           |          | 24                               | 340        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 19                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 3                                | DN         |     |
| 27  | 0100-Alongshore |  |           |                                   |   |                           |          | 19                               | 330        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 16                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | ON         |     |
| 27  | 0700-Alongshore | 38                                     | S         |                                   |   | 55                        | S        | 36                               | S          | 16  |
|     | Cross-shore     | 0                                      | 0         |                                   |   | 213                       | 0        | 0                                | South      | 23  |
|     | Resultant       | 38                                     | 160       |                                   |   | 55                        | 160      |                                  |            | 2   |
| 27  | 1300-Alongshore |  |           |                                   |   |                           |          | 23                               | 334        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 22                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | ON         |     |
| 27  | 1900-Alongshore |  |           |                                   |   |                           |          | 22                               | 335        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 29                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | ON         |     |
| 28  | 0100-Alongshore |  |           |                                   |   |                           |          | 29                               | 336        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 33                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | ON         |     |
| 28  | 0700-Alongshore | 68                                     | S         |                                   |   | 76                        | S        |                                  |            | 33  |
|     | Cross-shore     | 0                                      | 0         |                                   |   | 249                       | 0        | 0                                | No Reading | 34  |
|     | Resultant       | 68                                     | 160       |                                   |   | 76                        | 160      |                                  |            | 3   |
| 28  | 1300-Alongshore |  |           |                                   |   |                           |          | 34                               | 335        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 38                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | ON         |     |
| 28  | 1900-Alongshore |  |           |                                   |   |                           |          | 38                               | 338        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 33                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | ON         |     |
| 29  | 0100-Alongshore |  |           |                                   |   |                           |          | 33                               | 336        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 18                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | ON         |     |
| 29  | 0700-Alongshore | 55                                     | S         |                                   |   | 41                        | S        | 74                               | S          | 18  |
|     | Cross-shore     | 0                                      | 0         |                                   |   | 213                       | 4        | Off                              | South      | 20  |
|     | Resultant       | 55                                     | 160       |                                   |   | 41                        | 160      |                                  |            | 5   |
| 29  | 1300-Alongshore |  |           |                                   |   |                           |          | 20                               | 353        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 10                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 3                                | OF         |     |
| 29  | 1900-Alongshore |  |           |                                   |   |                           |          | 11                               | 357        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 18                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 2                                | OF         |     |
| 30  | 0100-Alongshore |  |           |                                   |   |                           |          | 18                               | 345        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 9                                | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | ON         |     |
| 30  | 0700-Alongshore | 32                                     | S         |                                   |   | 12                        | S        | 46                               | S          | 9   |
|     | Cross-shore     | 5                                      | Off       |                                   |   | 152                       | 18       | Off                              | South      | 13  |
|     | Resultant       | 32                                     | 150       |                                   |   | 22                        | 104      |                                  |            | 2   |
| 30  | 1300-Alongshore |  |           |                                   |   |                           |          | 13                               | 334        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          |                                  |            |     |
|     | Resultant       |  |           |                                   |   |                           |          |                                  |            |     |
| 30  | 1900-Alongshore |  |           |                                   |   |                           |          |                                  |            |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 18                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | OF         |     |
| 31  | 0100-Alongshore |  |           |                                   |   |                           |          | 18                               | 343        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 15                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 1                                | ON         |     |
| 31  | 0700-Alongshore | 47                                     | S         |                                   |   | 61                        | S        | 42                               | S          | 15  |
|     | Cross-shore     | 5                                      | On        |                                   |   | 164                       | 0        | 0                                | North      | 336 |
|     | Resultant       | 47                                     | 154       |                                   |   | 61                        | 157      |                                  |            | 0   |
| 31  | 1300-Alongshore |  |           |                                   |   |                           |          | 11                               | 340        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 21                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 0                                |            |     |
| 31  | 1900-Alongshore |  |           |                                   |   |                           |          | 21                               | 340        |     |
|     | Cross-shore     |  |           |                                   |   |                           |          | 20                               | N          |     |
|     | Resultant       |  |           |                                   |   |                           |          | 0                                |            |     |
|     |                 |  |           |                                   |   |                           |          | 20                               | 340        |     |

KEY = ALL SPEEDS IN CM/SEC  
N = NORTHWARD, SHORE PARALLEL  
S = SOUTHWARD, SHORE PARALLEL  
ON=ONSHORE  
OF=OFFSHORE

## V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5  
SUPPLEMENTAL OBSERVATIONS

DEC 1985

| WAVE APPROACH ANGLE: |      |                 |             | WATER CHARACTERISTICS: |              |               |               |
|----------------------|------|-----------------|-------------|------------------------|--------------|---------------|---------------|
|                      |      | AT PIER END     | RADAR WAVE: |                        |              | AT PIER END   |               |
| DAY                  | TIME | deg from True N | ANGLE deg:  | WIDTH OF               |              | DENSITY:SECCI |               |
|                      |      | Primary         | Secondary   | from True N            | SURF ZONE(m) | TEMP(C)       | (g/cc) VIS(m) |
| 1                    | 1000 | 60              |             | 65                     | 552          | 12.0          | 1.0214 0.3    |
| 2                    | 822  | 30              | 65          | 80                     | 451          | 12.5          | 1.0214 0.3    |
| 3                    | 813  | 95              |             | 90                     | 251          | 13.4          | 1.0233 0.9    |
| 4                    | 837  | 90              |             | 90                     | 87           | 13.0          | 1.0232 0.6    |
| 5                    | 800  | none visible    |             | 80                     | 76           | 12.3          | 1.0228 0.9    |
| 6                    | 802  | 50              |             |                        | 108          | 11.6          | 1.0230 0.9    |
| 7                    | 952  | 90              |             | 80                     | 104          | 10.6          | 1.0224 0.6    |
| 8                    | 852  | 90              |             | 80                     | 143          | 10.5          | 1.0222 1.8    |
| 9                    | 720  | 90              |             |                        | 59           | 11.0          | 1.0221 1.8    |
| 10                   | 710  | 110             |             |                        | 69           | 13.3          | 1.0235 0.9    |
| 11                   | 750  | 50              |             | 60                     | 277          | 13.0          | 1.0236 0.9    |
| 12                   | 715  | 60              | 95          |                        | 90           | 11.7          | 1.0231 0.9    |
| 13                   | 910  | 35              |             | 50                     | 105          | 10.5          | 1.0231 0.9    |
| 14                   | 935  | 35              |             | 70                     | 119          | 10.0          | 1.0225 1.8    |
| 15                   | 715  | 100             | 30          |                        | 47           | 10.4          | 1.0226 1.5    |
| 16                   | 730  | 110             | 30          | inoperative            | 27           | 10.4          | 1.0226 1.8    |
| 17                   | 817  | 10              |             | 30                     | 43           | 10.8          | 1.0226 1.2    |
| 18                   | 711  | 60              |             | 60                     | 98           | 10.0          | 1.0219 1.8    |
| 19                   | 705  | 15              |             | 30                     | 95           | 9.8           | 1.0224 1.2    |
| 20                   | 730  | 30              |             | 70                     | 213          | 9.9           | 1.0228 1.5    |
| 21                   | 730  | 20              | 65          | 70                     | 384          | 9.1           | 1.0228 0.6    |
| 22                   | 740  | 20              |             | 70                     | 274          | 6.4           | 1.0230 0.6    |
| 23                   | 715  | 50              | 90          | 20                     | 122          | 8.7           | 1.0227 0.6    |
| 24                   | 900  | 90              |             | 90                     | 122          | 9.5           | 1.0226        |
| 25                   | 900  | 105             |             | inoperative            | 201          | 8.9           | 1.0244 0.9    |
| 26                   | 940  | 20              | 30          |                        | 123          | 8.5           | 1.0216 1.2    |
| 27                   | 740  | 30              |             | 30                     | 149          | 8.2           | 1.0218 1.2    |
| 28                   | 711  | 40              |             | 40                     | 265          | 7.6           | 1.0210 0.9    |
| 29                   | 700  | 20              |             | 20                     | 144          | 7.2           | 1.0204 1.2    |
| 30                   | 730  | 20              |             | 20                     | 61           | 7.6           | 1.0213 0.9    |
| 31                   | 815  | 50              |             | 55                     | 136          | 7.3           | 1.0212 0.6    |

## VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865- 1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

FRF TIDE HEIGHTS  
DEC 1986

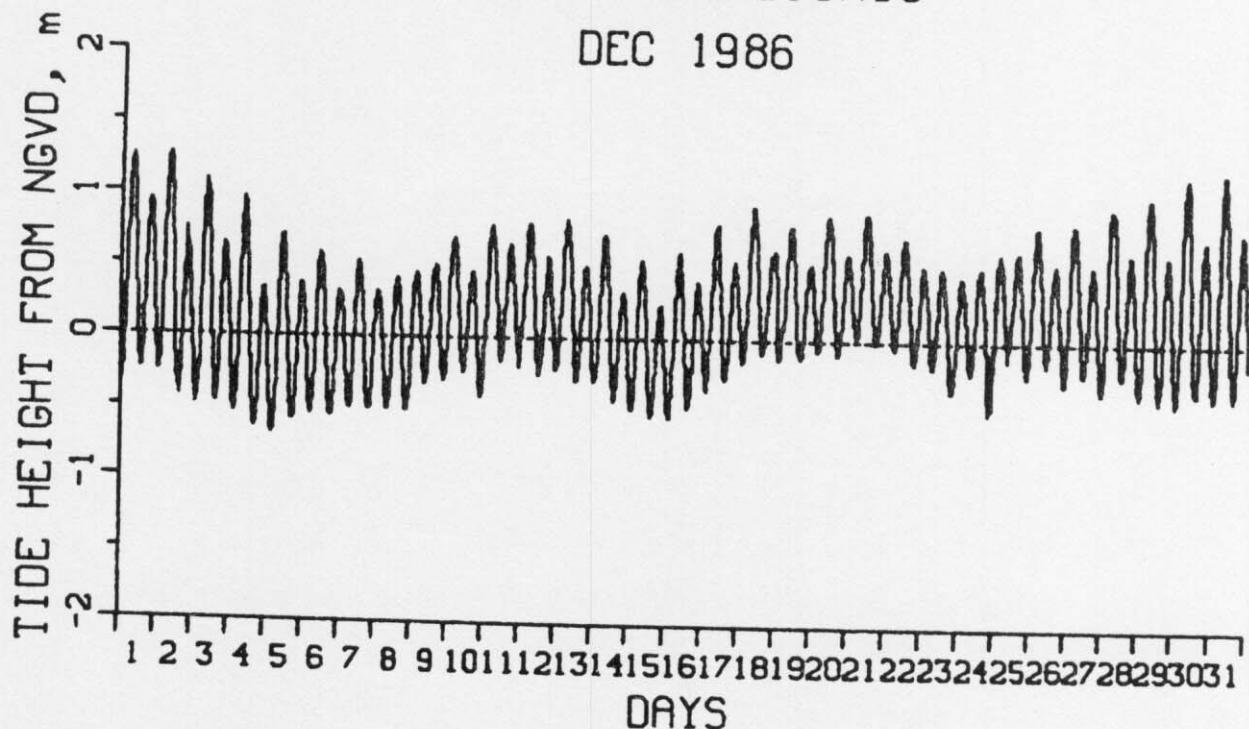


FIGURE 4. Time History of Mean Water Levels, December 1986

MONTHLY MEAN WATER LEVELS (METERS MSL)

|                   |                                  |
|-------------------|----------------------------------|
| Extreme Low -     | -0.69 on 5 December at 0330 hrs. |
| Extreme High -    | 1.27 on 2 December at 0742 hrs.  |
| Monthly Mean -    | 0.18                             |
| Mean Low Water -  | -0.35                            |
| Mean High Water - | 0.67                             |
| Mean Range -      | 1.03                             |

| MID-CYCLE<br>DAY | LOW<br>TIME | HIGH | MEAN | RANGE |
|------------------|-------------|------|------|-------|
|------------------|-------------|------|------|-------|

|    |      |       |      |       |      |
|----|------|-------|------|-------|------|
| 1  | 612  | -0.31 | 1.25 | 0.53  | 1.56 |
| 1  | 1837 | -0.25 | 0.94 | 0.34  | 1.19 |
| 2  | 703  | -0.30 | 1.27 | 0.52  | 1.57 |
| 2  | 1928 | -0.48 | 0.75 | 0.09  | 1.23 |
| 3  | 753  | -0.44 | 1.08 | 0.33  | 1.52 |
| 3  | 2018 | -0.54 | 0.65 | 0.05  | 1.19 |
| 4  | 843  | -0.58 | 0.96 | 0.20  | 1.54 |
| 4  | 2109 | -0.68 | 0.33 | -0.20 | 1.01 |
| 5  | 934  | -0.69 | 0.70 | 0.06  | 1.40 |
| 5  | 2159 | -0.59 | 0.37 | -0.13 | 0.96 |
| 6  | 1024 | -0.55 | 0.58 | 0.03  | 1.12 |
| 6  | 2249 | -0.56 | 0.32 | -0.11 | 0.88 |
| 7  | 1115 | -0.50 | 0.52 | 0.02  | 1.03 |
| 7  | 2340 | -0.52 | 0.31 | -0.10 | 0.83 |
| 8  | 1205 | -0.51 | 0.41 | -0.04 | 0.92 |
| 9  | 30   | -0.52 | 0.45 | 0.01  | 0.97 |
| 9  | 1255 | -0.33 | 0.52 | 0.10  | 0.84 |
| 10 | 121  | -0.30 | 0.69 | 0.22  | 1.00 |
| 10 | 1346 | -0.30 | 0.45 | 0.08  | 0.76 |
| 11 | 211  | -0.41 | 0.78 | 0.25  | 1.19 |
| 11 | 1436 | -0.17 | 0.64 | 0.25  | 0.81 |
| 12 | 301  | -0.20 | 0.80 | 0.32  | 1.00 |
| 12 | 1527 | -0.26 | 0.57 | 0.12  | 0.83 |
| 13 | 352  | -0.22 | 0.83 | 0.33  | 1.05 |
| 13 | 1617 | -0.30 | 0.50 | 0.09  | 0.80 |
| 14 | 442  | -0.31 | 0.73 | 0.20  | 1.04 |
| 14 | 1707 | -0.45 | 0.32 | -0.07 | 0.77 |
| 15 | 532  | -0.49 | 0.55 | 0.05  | 1.04 |
| 15 | 1758 | -0.55 | 0.23 | -0.19 | 0.78 |
| 16 | 623  | -0.55 | 0.60 | 0.04  | 1.15 |
| 16 | 1848 | -0.48 | 0.40 | -0.03 | 0.88 |
| 17 | 713  | -0.36 | 0.80 | 0.25  | 1.15 |
| 17 | 1938 | -0.29 | 0.55 | 0.13  | 0.84 |
| 18 | 804  | -0.16 | 0.93 | 0.41  | 1.09 |
| 18 | 2029 | -0.14 | 0.63 | 0.25  | 0.77 |
| 19 | 854  | -0.11 | 0.80 | 0.36  | 0.90 |
| 19 | 2119 | -0.12 | 0.53 | 0.20  | 0.66 |
| 20 | 944  | -0.08 | 0.87 | 0.41  | 0.95 |
| 20 | 2210 | -0.10 | 0.61 | 0.27  | 0.71 |
| 21 | 1035 | -0.02 | 0.89 | 0.45  | 0.91 |
| 21 | 2300 | -0.06 | 0.63 | 0.28  | 0.69 |
| 22 | 1125 | -0.13 | 0.73 | 0.31  | 0.86 |
| 22 | 2350 | -0.18 | 0.53 | 0.17  | 0.71 |
| 23 | 1216 | -0.35 | 0.51 | 0.13  | 0.86 |
| 24 | 41   | -0.34 | 0.45 | 0.07  | 0.79 |
| 24 | 1306 | -0.51 | 0.51 | 0.13  | 1.02 |
| 25 | 131  | -0.46 | 0.62 | 0.17  | 1.07 |
| 25 | 1356 | -0.23 | 0.62 | 0.24  | 0.86 |
| 26 | 222  | -0.23 | 0.80 | 0.32  | 1.04 |
| 26 | 1447 | -0.29 | 0.54 | 0.16  | 0.83 |
| 27 | 312  | -0.28 | 0.83 | 0.33  | 1.11 |
| 27 | 1537 | -0.34 | 0.54 | 0.12  | 0.88 |
| 28 | 402  | -0.34 | 0.94 | 0.37  | 1.28 |
| 28 | 1628 | -0.37 | 0.63 | 0.13  | 1.00 |
| 29 | 453  | -0.37 | 1.01 | 0.37  | 1.38 |
| 29 | 1718 | -0.42 | 0.62 | 0.08  | 1.04 |
| 30 | 543  | -0.40 | 1.17 | 0.41  | 1.56 |
| 30 | 1808 | -0.35 | 0.74 | 0.15  | 1.09 |
| 31 | 634  | -0.38 | 1.20 | 0.44  | 1.58 |

TABLE 6

WATER LEVELS (METERS MSL)  
Tidal Characteristics

## VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in November and the two surveys taken during December on profile line 188, located 517 m south of the pier. The first survey in December followed a major storm ("Northeaster" on 1 and 2 December), and shows substantial changes to the profile. A small berm (120 m) present on the foreshore during November was completely removed. In addition, the nearshore bar (120 to 280 m) almost doubled in width and migrated 40 m offshore. The storm bar (280 to 550 m) also showed substantial development and migrated offshore over 100 m. Only minor changes were visible on the remainder of the profile.

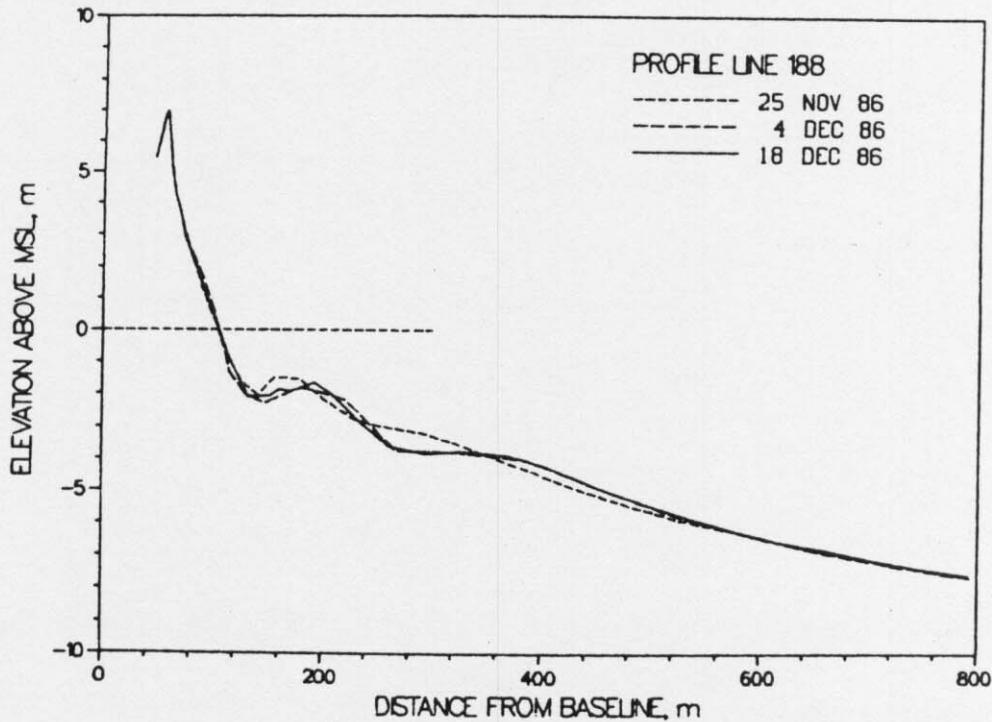


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during December, which are a result of bar movements. The nearshore change (200 m) represents the crest of the nearshore bar following its offshore migration. The offshore change (300 m) reflects the development of the trough separating the nearshore and offshore bars.

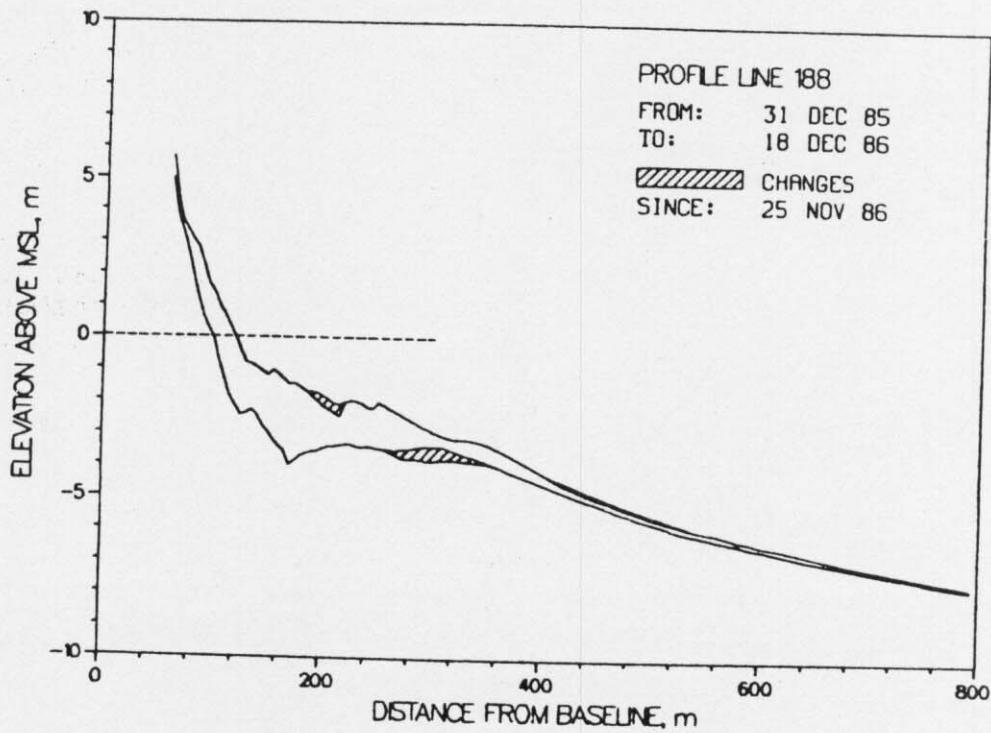


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. The bathymetric survey (Figure 7) completed on 5 December shows a widening and deepening of the trough under the pier especially on the north side. Because the survey followed a storm on 1-3 December, the most significant changes were deepening of the nearshore trough and accretion on both the nearshore bar and the storm bar.

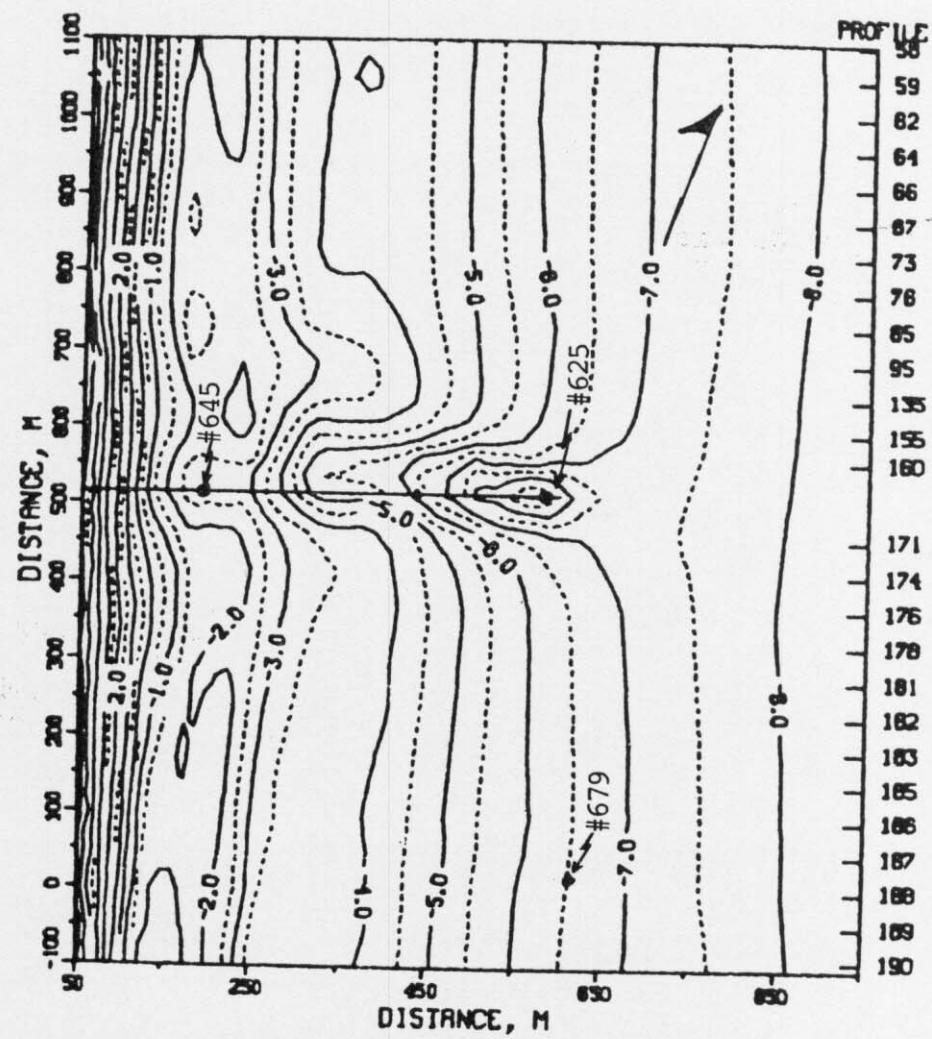


Figure 7. FRF BATHYMETRY 5 DEC 86  
CONTOURS IN METERS

## VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor gage #625 at pier station 19+00) exceeded 2 m and wave records were obtained every hour:

| <u>Start</u>  | <u>End</u>    |
|---------------|---------------|
| (0000) 1 Dec  | (0800) 3 Dec  |
| (1700) 24 Dec | (0000) 25 Dec |

### B. Storm Synopsis.

1-3 December - Following the classic pattern for the development of a major "Northeaster", this storm was spawned in the Gulf of Mexico early on 28 November. By 1 December, the storm center had moved into the Atlantic Ocean off northern Florida. The blocking effects of a strong Canadian high pressure system served to both slow the storm's movement up the East Coast and contributed to the onshore gale force winds which buffeted the FRF for a substantial period of time. By 2 December, the storm was still located south of the FRF. However, later in the day it accelerated and was centered over New England on 3 December. Onshore winds exceeded 18 m/s (NE) at 1900 hrs. on 1 December, but remained above 15 m/s for 22 hrs. The maximum Hmo (Gage #625) of 3.13 m (9.75 sec period) was recorded at 0700 hrs. on 2 December. The lowest barometric reading was 1005.9 mb at 0100 hrs. on 3 December. Total precipitation was 21 mm.

24 December - This storm also developed in the Gulf of Mexico. However, its northeasterly track took it well inland (west of the Appalachians) which substantially reduced its effect on the East Coast. Onshore winds approached 14 m/s (SE), but were above 10 m/s for only 3 hours. The maximum Hmo (Gage #625) of 2.65 m (10.34 sec period) was recorded at 1800 hrs. on 24 December. The lowest barometric reading was 1004.2 mb at 1900 hrs. on 24 December. Total precipitation was 18 mm.

## Distribution List

### Government Agencies:

OCE  
BERH  
NAO  
NASA/Wallops Flight Center  
NOAA (NOS, NWS)  
SAD

SAW

U.S. Geological Survey  
U.S. National Park Service  
U.S. Naval Academy  
U.S. Naval Civil Eng. Lab  
U.S. Naval Fac. Eng. Com.  
U.S. Naval Oceanographic Off.

U.S. Naval Research Lab

### Colleges/Universities:

California Inst. of Tech.  
East Carolina University  
Florida Inst. of Tech.  
Naval Post Graduate School  
NC State University  
Old Dominion University  
Oregon State University  
Prince George's College  
Rutgers University  
Scripp Inst. of Oceanography  
Southern Illinois University

Stockton State College  
University of Akron  
University of Delaware  
University of Florida  
University of Maryland  
University of Miami  
University of North Carolina  
University of N. Colorado  
University of Rhode Island  
University of Virginia  
Va. Inst. of Marine Science

### Others:

City of Va. Beach, VA  
Coastal Barge Corporation  
Coastal and Est. Res., Inc.  
Coastal Science & Eng., Inc.  
Dr. Galvin  
GEOMET Tech., Inc.  
Greenhorne & O'Mara, Inc.  
Dr. Hylton  
Mary Marr, Inc.  
Masonite Corporation  
MEC Systems Corporation

Moffatt & Nichol, Eng.  
Offshore Coastal Technologies  
Mr. Rowland  
Mr. Savage  
Sea Port Supply Corp.  
Shell Development  
Sherwood Industries  
Sohio Petroleum Co.  
Mr. & Mrs. Valpey  
WCTI-TV

### Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Queen's University, Ontario (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)